Cluster with lensed quasar

Basic Steps:

1. Find the 110 ksec Chandra Observation of UM425 in archive.
   Obsid:
2. What mode was Chandra observing in:
3. Does data need to be reprocessed? Why or why not?
4. Create a soft-band image (0.3 - 2.5 keV) that highlights the diffuse emission near UM425

Advanced Topics:

1. Hardness ratio:
   (a) Extract the soft (0.3 - 2.5) and hard (2.5 - 8) counts for both UM425A and UM425B.
   (b) Determine the hardness ratio (H-S)/(H+S) for both sources and calculate the uncertainty assuming gaussian statistics. Is this assumption valid?
   (c) Using your estimated values, at what confidence are the two source spectra different?
   (d) Discuss how you could derive a good estimate of hardness ratio uncertainty in the low-counts regime

2. Luminosity

   (a) Assume that you observe a net of 200 counts in ACIS-S in the 0.3 to 3 keV range for a cluster at redshift $z = 1$. Calculate the cluster luminosity $L_x(0.6 - 6\mathrm{keV})$ (rest-frame) assuming a Raymond-Smith plasma with temperature $kT = 2\,\mathrm{keV}$ and an abundance of 0.2 solar. Set the Galactic absorption to $2 \times 10^{20}\,\mathrm{cm}^{-2}$.

   HINT: Use PIMMS (`http://asc.harvard.edu/toolkit/pimms.jsp`) and Ned Wright's Cosmology calculator (`http://www.astro.ucla.edu/~wright/CosmoCalc.html`) with the default cosmology to derive the luminosity distance D_L for transforming flux to luminosity.

   (b) How sensitive is this estimate to the assumed temperature?

3. Spectrum of UM425A (the bright source)

   (a) Make a rough estimate of the contamination of the quasar spectrum by the diffuse emission. Is it safe to ignore this?

   (b) Extract a spectrum for UM425A using `psextract` following the thread `http://asc.harvard.edu/ciao/threads/psextract/`. (Skip this step and use the supplied files if short on time).

   (c) Use the supplied script to fit a simple power law with Galactic absorption to the spectrum. Is this an acceptable fit?

   (d) Find the model for 'Redshifted partial covering absorption' (using `ahelp xs` in Sherpa). Add this intrinsic absorption component to your model, using $z = 1.465$. Does this now give an acceptable fit? What is the interpration of partial covering in this model?

Suggested reading:
"Lens or Binary? Chandra Observations of the Wide Separation Broad Absorption Line Quasar Pair UM 425" by Aldcroft & Green 2003, ApJ, 592, 710
"Discovery of a Galaxy Cluster in the Foreground of the Wide-Separation Quasar Pair UM425" by Green et al. 2005, astro-ph/0505248